A COMPARATIVE STUDY OF RESULTS OF CORRECTION OF CLUBFOOT DEFORMITY BY TURCO'S PROCEDURE AND MODIFIED TURCO'S PROCEDURE

DISSERTATION SUBMITTED FOR
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CHENNAI, TAMIL NADU

CERTIFICATE

This is to certify that the work entitled "**A COMPARATIVE STUDY OF RESULTS OF CORRECTION OF CLUBFOOT DEFORMITY BY TURCO'S PROCEDURE AND MODIFIED TURCO'S PROCEDURE"** which is being submitted for M.S. Orthopaedics, is a bonafide work of **Dr. K.SELVA GANESAN**, Post Graduate Student at Department of Orthopaedics, Tirunelveli Medical College, Tirunelveli.

DEAN

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He has completed the necessary period of stay in the Department and has fulfilled the conditions required for the submission of this thesis according to the University regulations. The study was undertaken by the candidate himself and the observations recorded have been periodically checked by us.

Recommended and forwarded

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This is to certify that the INSTITUTIONAL ETHICAL COMMITTEE OF TIRUNELVELI MEDICAL COLLEGE AND HOSPITAL, TIRUNELVELI– 11 has unanimously approved the dissertation titled "**A COMPARATIVE STUDY OF RESULTS OF CORRECTION OF CLUBFOOT DEFORMITY BY TURCO'S PROCEDURE AND MODIFIED TURCO'S PROCEDURE"** by **Dr.K.SELVA GANESAN**, MS Orthopaedics Post graduate student of Tirunelveli Medical College, Tirunelveli in its meeting held on 09.07.2008.

Tirunelveli,
09.07.2008

Sd/-
SECRETARY

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CONTENTS

INTRODUCTION

Clubfoot is the one of the most common problems in orthopaedics, it is characterized by a complex three-dimensional deformity of the foot. Incidence of clubfoot in India is 1.51 per thousand live birth and the incidence rises upto one in twenty if genetically predisposed. In the clubfoot the heel is inverted, the forefoot and midfoot are inverted and adducted, the ankle in equinus position and there is an associated internal tibial torsion. There is a malalignment of talocalcaneal, talonavicular and calcaneocuboid joints and these articular misalignment are firmly fixed by capsular ,ligamentous and musculotendinous contractures. In India, owing to the ignorance of parents, clubfoot remains a significant problem and yields an unpredictable outcome due to late presentation for treatment. Many children became physically handicapped due to ignorance of the deformity by parents. The treatment of clubfoot is continues to be one of the biggest challenges in orthopaedic community. Treatment of clubfoot deformity starts from the labour room with manipulation by parents followed by manipulation with strapping and manipulation with serial casting by treating orthopaedic surgeon. 30-50% of the feet will not be corrected by conservative methods and will need surgical correction. The general concept in the surgical treatment of clubfoot is to achieve complete and permanent correction with one operation. Decision to choose the categories of operative procedures depends on age of patient, degree of rigidity and presence of deformity. The surgical procedures that are soft tissue procedures, Combination of soft tissue and bony procedures, Bony procedures. The procedure that involves soft tissue consist of release or lengthening

of tight , deforming soft tissue structures such as ligaments, joint capsules and tendons, as well as performing tendon transfers. The comprehensive soft tissue release include the posteromedial release of Turco and circumferential release. Tendon transfers occasionally performed to provide dynamic balance between the evertors and invertors. In the child whose tarsal and metatarsal bones have become deformed and resist correction, a combination of soft tissue release and various bony procedures are considered. In those older than nine years of age, the lateral column of the foot is shortened and stabilized by calcaneocuboid resection and fusion of calcaneocuboid joint. Recurrence of deformity and wound complications resulting in further worsening of deformity occurs in Turco's posteromedial release. In this study we have modifying the turco's procedure by excising the abductor hallucis would reduce the recurrence of fore foot adduction and wound complications and also compares the results of treatment of clubfoot by two different surgical techniques.

AIM OF THE STUDY

This is a prospective and comparative analysis of the results of treatment of clubfoot by two different surgical techniques, namely Turco procedure and modified Turco procedure. Recurrence of forefoot adduction and wound dehiscence are common with posteromedial release described by Turco. In this study we modified the surgical procedure to reduce the recurrence of the deformity and wound complications and there by bring the deformed foot into painless, mobile and plantigrade foot,

HISTORIC REVIEW

Clubfoot was first depicted in ancient Egyptian tomb paintings, and treatment was described in India as early as 1000 B.C. The first written description of clubfoot was given to us by Hippocrates (circa 400 B.C.), who believed the causative factor to be mechanical pressure. He described methods for manipulative correction remarkably similar to current non-operative methods. Hippocrates understood two important principles in the treatment of clubfoot that the majority of cases can be successfully treated with serial manipulations, and that treatment should begin as early as possible before the deformity of the bones is well established. Hippocrates treated clubfoot as soon after birth as possible. His technique involved repeated manipulations of the involved foot with his hands, followed by the application of strong bandages to maintain correction.

In 1803, Scarpa treated club foot by forceful manipulation, not gentle stretching, and application of a complicated mechanical device, later known as Scarpa's shoe. His treatment method was never successful in other hands and for that reason was not widely accepted.

In 1823, Delpech performed subcutaneous tenotomy of the Achilles tendon. The high incidence of infection discouraged most surgeons from performing tenotomies..

In 1866, Adams was the first surgeon to draw attention to the error of dividing the Achilles tendon as the first stage in the correction of the deformity. Adams stated he believed the muscles were the deforming force, and that anatomically, clubfoot is a dislocation of the talocalcaneonavicular joint. He recommended early surgery to obtain anatomical reduction of the dislocation.

In 1838, M. Guerin described the use of plaster-of-Paris in the treatment of congenital clubfoot.

With the exception of tenotomies, the operative treatment of clubfoot began with the introduction of aseptic technique and anesthesia. In 1867, Lister introduced antiseptic principles of surgery. Esmarch in 1873 described a flat-rubber bandage for expressing blood from a limb. The introduction of the pneumatic tourniquet to limb surgery by Cushing in 1904 was invaluable.The introduction of radiography made possible the precise evaluation of deformities. The advent of anesthesia completed the surgical renaissance, and these advances set the stage for orthopaedic surgery to evolve from a specialty with much empirical craftsmanship into an important scientific discipline. However, in the case of clubfoot treatment, this evolution also allowed the development of more radical operations aimed to obtain a “perfect” foot.

In 1891, Phelps not only divided the Achilles tendon,but carried out a medial release of all soft tissues, elongation of the tibialis posterior and division of the medial ligament of the ankle joint and plantar fascia, abductor hallucis, flexor hallucis longus, all the short flexors and finally performed osteotomy of the neck of the talus and wedge resection of the calcaneus.

Tendon transfers first became popular in the 1920's.Dunn in 1922 described transfer of the tibialis anterior tendon in selected cases of clubfoot to prevent relapse Barr (1958) believed that the tibialis anterior tendon should not be transferred to a lateral insertion if peroneus longus is functioning, due to resultant muscle imbalance.

Denis Browne (1892-1967), a second generation Australian, became the father of pediatric surgery in the United Kingdom. He is best known in orthopaedics for his Denis Browne bar used to correct clubfoot; a similar abduction orthosis is still used today to maintain correction of the deformity.

Kite then became the leading advocate of the conservative treatment of clubfoot for many years in the early and mid 1900's.In 1964 he comprehensively outlined his technique of manipulation. He recommended abducting the forefoot against pressure at calcaneo cuboid joint.

In 1950, ponsetti described his method of treating clubfoot using manipulation and casting. He achieved plantigrade , plainless and mobile foot without the need for

open surgery in 95% of the cases.

Turco described surgical correction by posteromedial release in 1971 and published a monograph on the subject in 1981 .His approach and surgical technique seem to be favoured by most surgeons today.

In 1983 Mckay introduced complete subtalar release for stiff and medial spin deformity club foot with very good results.

INCIDENCE

The incidence of clubfoot varies widely with race and sex. The overall incidence of clubfoot was 1 to 2 per thousand live births

Serial no	Race	Cases per thousand
1.	Indian	1.51
2.	Polynesian	6.81
3.	Puerto Rican	1.36
4	Southafrican	3.50
5.	chinese	0.39
6.	Japanese	0.53
7.	Malay	0.68
8.	Fillipino	0.76
9.	Caucasian	1.12

Males out number females by 2:1 with 50% of cases being bilateral.

In those with unilateral deformity, there was a right sided predominance .

A higher incidence of clubfoot was also noted in patients with a positive family history. The possibility of clubfoot occurrence in a sibling was 1 in 35 and if present in an identical twin, the risk was 1 in 3. Although this was probably due to polygenetic influences, it was suggested that it might also be due to an autosomal dominance of poor penetrance.

In this study male female ratio is 3 ; 2 . 35 % of patients were bilateral. Two cases of club feet secondary to cerebral palsy and one case secondary to meningomyelocele.

ETIOLOGY

The true etiology of clubfoot remains unknown. Many theories have been put forward:

1. Mechanical factors in utero:

This is the oldest theory and was first proposed by Hippocrates. He believed that the foot was held in a position of equinovarus by external uterine compression. However, Parker in 1824 and Browne in 1939 believed that diminution of amniotic fluid, as in oligohydramnios, prevents fetal movement and renders the fetus vulnerable to extrinsic pressure.

2. Neuromuscular defect:

Some investigators still maintain the opinion that equinovarus foot is always the result of neuromuscular defect. On the other hand, others have shown no abnormalities in their histological studies and electromyographic studies of the muscles in clubfoot.

3. Primary germ plasma defect :

Irani and Sherman had dissected equinovarus feet and normal feet. In clubfoot, they found that the neck of talus was always short, with its anterior portion

rotated medially and plantarly. They suggested that the deformity probably resulted from a primary germplasm defect.

4. Arrested fetal development:

a) Intrauterine environment

In 1863, Heuter and Von Volkman first proposed that the arrest of fetal development early in embryonic life was a cause of congenital clubfoot. This theory was maintained by Bohm in 1929.

b) Environmental influences

The harmful influence of teratogenic agents on fetal environment and development are well exemplified by the effect of rubella and thalidomide in pregnancy. There are various environmental factors such as radiation hazard from radiation exposure from the diagnostic procedures and global warming responsible for the appearance of a clubfoot, as there are various substances capable of producing a temporary growth arrest.

5. Hereditary:

Clubfoot tends to be familial in a significant number of cases . It is inherited as having a polygenic multi factorial trait. Wynne-Davis stated that polygenic inheritance is more susceptible to the influence of environmental factors.

PATHOANATOMY

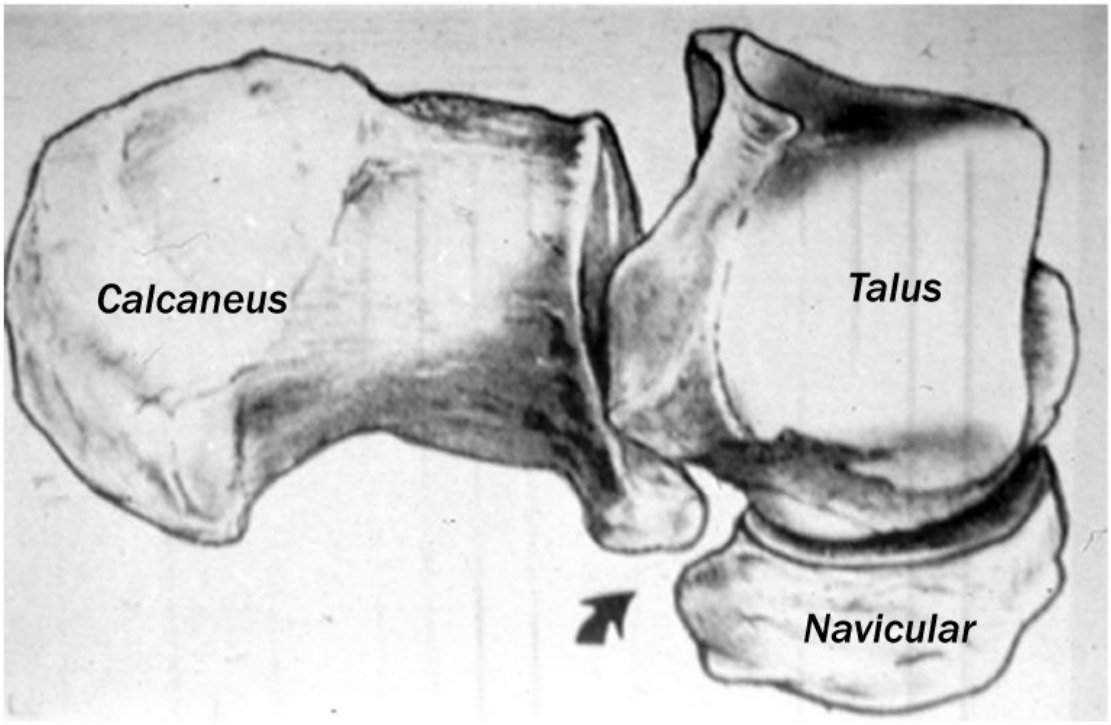
Basic Pathology

- Abnormal Tarsal Relation
- Congenital Dislocation / Subluxation of talocalcaneonavicular joint
- Soft Tissue Contracture
- Congenital Atresia

Bony changes

Bony changes are divided into intraosseous and interosseous and are tabulated below

Bony changes in clubfoot



Bone	Intraosseous	interossous
Talus	Head-medially and plantarly deviated and wedge shaped neck-short and medially deviated, internally rotated Body-small and externally rotated Neck Body angle-decreased from normal of 160 to 90	Plantar flexed and medially deviated
Calcaneum	Small in size, underdeveloped sustentaculum tali. the anterior articular surface is deformed and medially deviated.	Plantar flexed, inverted and internally rotated
Cuboid	Normal in shape	Displaced medially and articulates with the non articular portion of

		calcaneum
Metatarsal	Normal in shape	Supinated, adducted at mid tarsal joints. plantar flexed first metatarsal.
Navicular	Wedge shaped hypertrophy of navicular tuberosity	Displaced medially and plantarwards. articulate with medial side of neck of talus. lateral half of head of talus is uncovered.
Tibia	Normal in shape	Internal tibial torsion.

Soft Tissue changes :

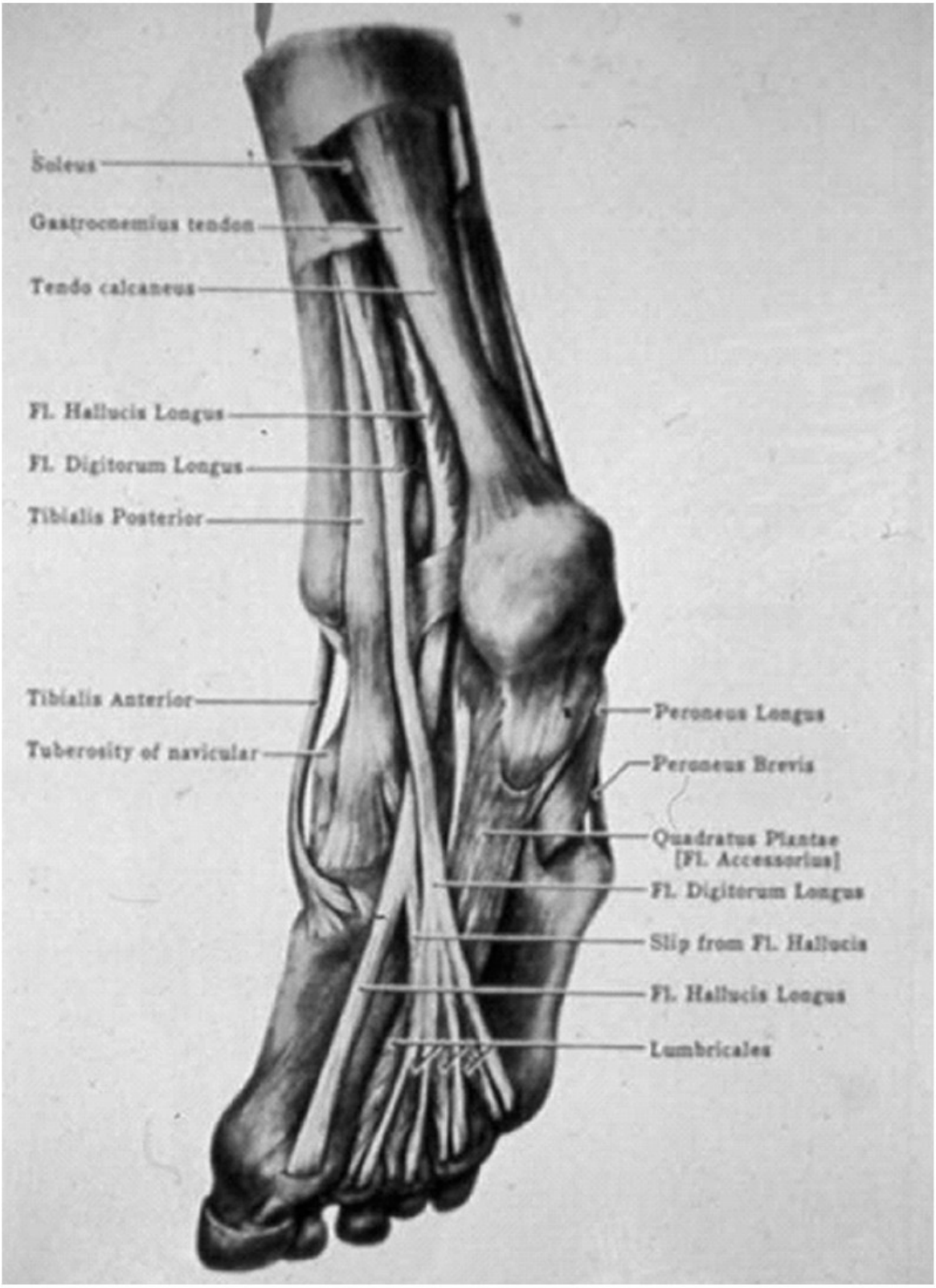
Shortening and Contracture in the Concave Side

1 - Muscles
2 - Tendons
3 - Ligaments
4 - Joints Capsule
5 - Skin
6 - Nerves & Vessels

MEDIAL PLANTAR STRUCTURES

Tendons	Tibialis posterior
Ligaments And capsules	Talonavicular capsule ,deltoid ligament, talonavicular ligament, deep plantar ligament, plantar aponeurosis, Master knot of Henry

Muscles	Abductor hallucis, intrinsic toe flexors, quadratus plantae.



Soft tissues around the angle joint and foot

POSTERIOR STRUCTURES

Tendon	Tendoachilles, peroneal tendon and its sheeth
Capsule	Tibiotalar and subtalar capsule
Ligaments	posterior talofibular ligaments

LATERAL STRUCTURES

Tendon	**Peroneal tendon and its sheath**
Ligaments	Calcaneofibular ligament, posterior talofibular ligaments peroneal retinaculum

Turco attributed the deformity to medial displacement of the navicular and calcaneus around the talus. According to Turco, the talus is forced into equinus by the underlying calcaneus and navicular, while the head and neck of the talus are deviated medially. The calcaneus is inverted under the talus, with the posterior end displaced upward and laterally and the anterior end displaced downward and medially.

McKay added an awareness of the three-dimensional aspect of bony deformity of the subtalar complex in clubfoot. According to his description, the relationship of the calcaneus to the talus is characterized by abnormal rotation in the sagittal, coronal, and horizontal planes. As the calcaneus rotates horizontally while pivoting on the interosseous ligament, it slips beneath the head and neck of the talus anterior to the ankle joint and the calcaneal tuberosity moves toward the fibular malleolus posteriorly.

Thus the proximity of the calcaneus to the fibula is primarily caused by horizontal rotation of the talocalcaneal joint rather than by equinus alone. The heel appears to be in varus because the calcaneus rotates through the talocalcaneal joint in a coronal plane as well as horizontally. The talonavicular joint is in an extreme position of inversion as the navicular moves around the head of the talus. The cuboid is displaced medially on the calcaneus.

Contractures or anomalies of the soft tissues exert further deforming forces and resist correction of bony deformity and realignment of the joints.

Talocalcaneal joint realignment is opposed by the calcaneofibular ligament, the superior peroneal retinaculum (calcaneal fibular retinaculum), the peroneal tendon sheaths, and the posterior talocalcaneal ligament.

Resisting realignment of the talonavicular joint are the tibialis posterior, the deltoid ligament (tibial navicular), the calcaneonavicular ligament (spring ligament), the entire talonavicular capsule, the dorsal talonavicular ligament, the bifurcated (Y) ligament, the inferior extensor retinaculum, and occasionally the cubonavicular oblique ligament.

Internal rotation of the calcaneocuboid joint causes contracture of the bifurcated

(Y) ligament, the long plantar ligament, the plantar calcaneocuboid ligament, the navicular cuboid ligament, the inferior extensor retinaculum (cruciate ligament), the dorsal calcaneocuboid ligament, and occasionally the cubonavicular ligament.

The metatarsals often are also deformed. They may deviate at their tarsometatarsal joints, or these joints may be normal and the shafts of the metatarsals themselves may be adducted.

If the clubfoot is allowed to remain deformed, many other late adaptive changes occur in the bones. These changes depend on the severity of the soft tissue contractures and the effects of walking. In untreated adults, some of the joints may spontaneously fuse, or they may develop degenerative changes secondary to the contractures.

RADIOGRAPHIC EVALUATION

Roentgenograms should be included as part of the evaluation of clubfoot, before, during, and after treatment.

In a nonambulatory child, standard roentgenograms include anteroposterior and stress dorsiflexion lateral roentgenograms of both feet.

Anteroposterior and lateral standing roentgenograms may be obtained for an older child.

Important angles to consider in the evaluation of clubfoot are

1. talocalcaneal angle on the anteroposterior roentgenogram
2. talocalcaneal angle on the lateral roentgenogram
3. talus–first metatarsal angle

The anteroposterior talocalcaneal angle in normal children ranges from 30 to 55degrees . In clubfoot this angle progressively decreases with increasing heel varus.

On the dorsiflexion lateral roentgenogram, the talocalcaneal angle in a normal foot varies from 25 to 50 degrees; in clubfoot this angle progressively decreases with the severity of the deformity to an angle of zero.

The tibiocalcaneal angle in a normal foot is 10 to 40 degrees on the stress lateral roentgenogram. In clubfoot this angle generally is negative, indicating equinus of the calcaneus in relation to the tibia.

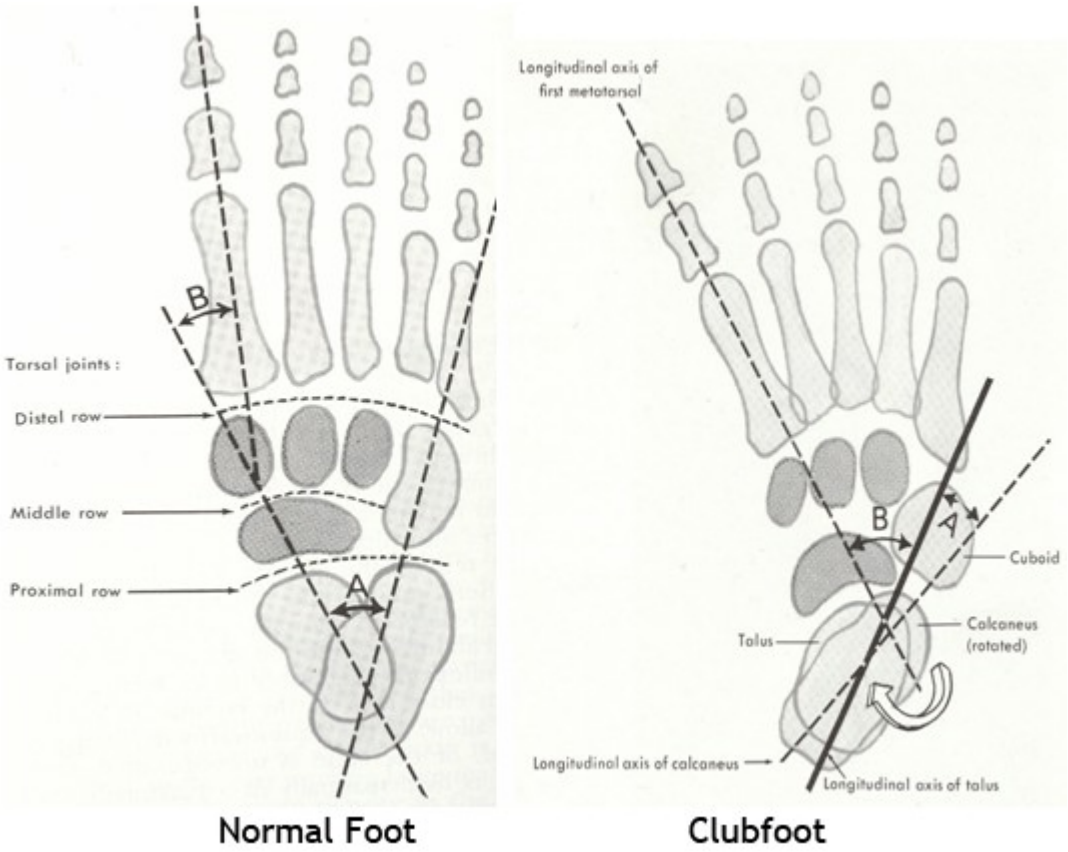
The talus–first metatarsal angle is a roentgenographic measurement of forefoot adduction. This is useful in the treatment of metatarsus adductus alone but is equally important in the treatment of clubfoot to evaluate the position of the forefoot. In a

normal foot, this angle is 5 to 15 degrees on the anteroposterior view; in clubfoot, it usually is negative, indicating adduction of the forefoot

In a mathematical model to predict the probability of clubfoot correction, a difference of 20 degrees between the lateral talocalcaneal angles measured on the stress dorsiflexion and plantarflexion views indicated a 93% probability that the hindfoot deformity had been adequately corrected.

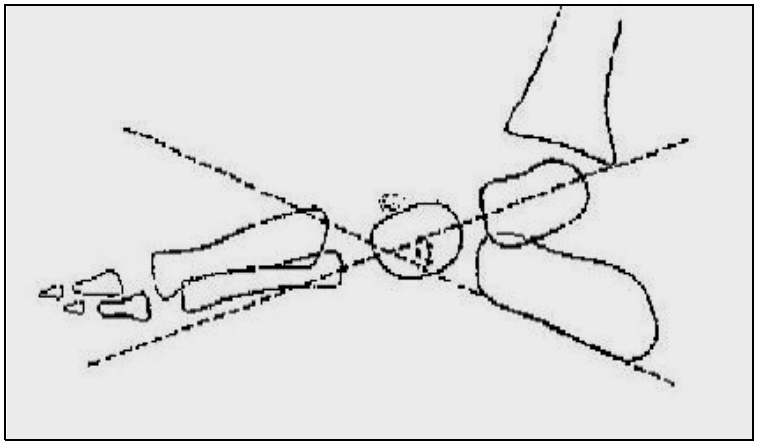
Roentgenographic findings correlate well with the clinical appearance of the foot and with the result after nonsurgical and surgical treatment. Adequate roentgenograms should be obtained during treatment to ensure that the foot is corrected not only clinically but also roentgenographically.

If the deformity is unilateral, the normal foot can be used as a control to determine roentgenographic correction.



Normal Foot Clubfoot

Angle A : talocalcaneal angle **Angle B : talo firstmetatarsal angle**



Stress dorsiflexion lateral view - talocalcaneal angle

Normal radiological measurements

Roentgenogram	Normal values (degrees)
Anteroposterior view	
1.talocalcaneal	20 to 50
2.talo-first metatarsal	0 to -20
3. talo- fifth metatarsal	0
Lateral view	
1. talo calcaneal	25 to 50
2. tibiotalar	70 to 100
Talocalcaneal index	Greater than 40

Anteroposterior projection of a healthy foot shows that the line through the long axis of the talus passes just medial to the base of the first metatarsal. The talocalcaneal angle measurement is shown. The normal range is 15-40°.

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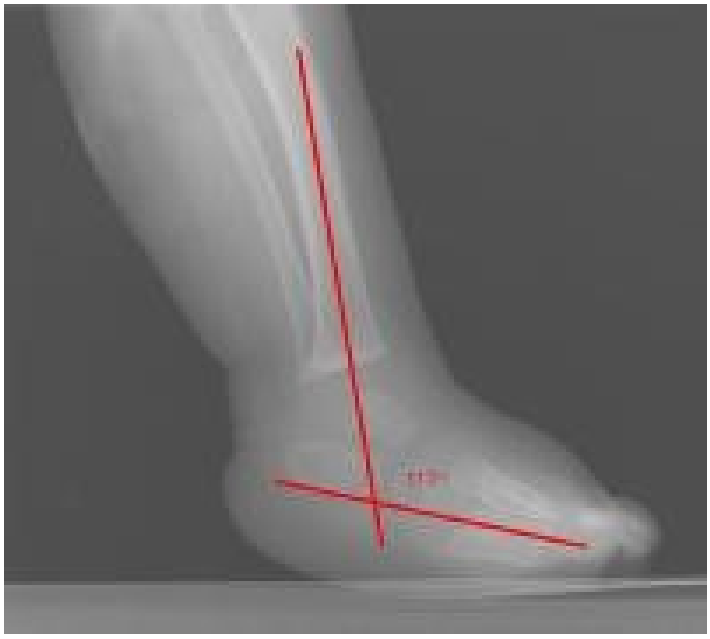
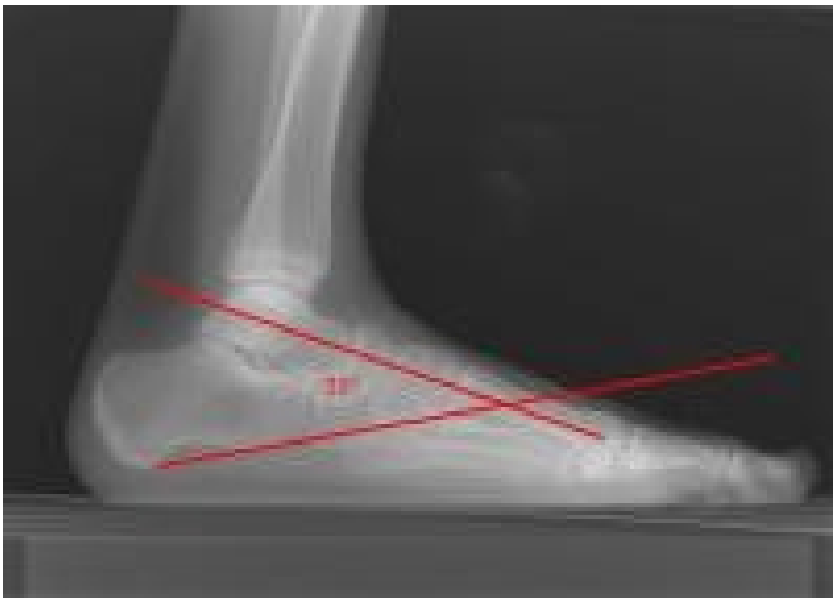
Anteroposterior views obtained in a patient with unilateral clubfoot show that the talus and calcaneus are more overlapped than in the normal condition. The talocalcaneal angle is 15° or less.



Lateral view in talipes equinovarus demonstrates an abnormally elevated tibiocalcaneal angle. A normal angle is 60-90.



Normal lateral view shows the measurement of the talocalcaneal angle. The calcaneal long axis is drawn along the plantar surface. The normal range is 25-45°.

In the antero-posterior view lines are drawn longitudinally through the talus parallel to its medial border, and through the calcaneus parallel to its lateral border. The angle subtended is measured. In the lateral view, lines are drawn longitudinally through the central axis of the talus, and parallel to the lower border of the body of the calcaneus These two angles are then added together, and we have called their sum the talo-calcaneal index described by Beatson and Pearson. If the talocalcaneal index is less than 40 degrees in properly positioned foot,.talocalcaneonavicular subluxation has not been reduced.

MRI and CT scanning have been recommended for preoperative and postoperative evaluation of clubfoot deformities, but we have not found these necessary for most patients

CLASSIFICATION

1. ETIOLOGICAL CLASSIFICATION

Postural Equino-Varus

Deformities are flexible and correctable

Idiopathic (Unknown Etiology) :

Congenital Talipes Equino-Varus CTEV

Congenital clubfoot or CTEV occurs typically in an otherwise normal child.

Acquired, Secondary to :

CNS Disease : Spina bifida, Poliomyelitis

Absent Bone : fibula / tibia

Teratologic club foot

1. Arthrogryposis
2. Diastropic dysplasia
3. Streeters dysplasia
4. Freeman Sheldon syndrome
5. Larsen syndrome
6. Myelodysplasia
7. Mobius syndrome
8. Pierre robin syndrome
9. Goldenher syndrome
10. Spinal muscular dystrophy
11. Muscular dystrophy
12. Chromosomal abnormality

Classification system for management and prognosis:

Dimeglio in 1991 divided clubfeet into four categories based on joint motion and ability to reduce the deformities .

Grade 1. Soft foot – may also be called postural foot and corrected by standard casting or physiotherapy treatment.

Grade 2. Soft > Stiff foot – It is usually a long foot which is more than 50% reducible and responds initially to casting . The varus, equines and supination deformities less than 20 degrees. However, if total correction has not been achieved after 7 or 8 months, surgery must be performed.

Grade 3. Stiff > Soft foot – It is less than 50% reducible . The varus, equinus and supination between 20 degree to 45 degree. After casting or physiotherapy, it is released surgically according to specific requirements.

Grade 4. Stiff foot – it is teratologic and the reduciblility is less than 20 %.varus, equinus and supination deformities are morethan 45 degrees. It is often bilateral and requires an extensive surgical correction.

Hersch divides idiopathic clubfeet into two varieties :

1) An intrinsic type associated with marked fibrosis and abnormal bony relationships, which is usually not responsive to non-operative treatment.

2) An extrinsic type which is not associated with significant fibrosis, and responds readily to gentle manipulation with plaster casts.

Features	Extrinsic	Intrinsic
Foot	Normal size,mild varus	Smaller , marked varus
Heel	Normal size,mild varus	Smaller elevated
Creases	More or less normal	Deep medial, posterior and plantar creases, reduced creases laterally
Telescoping	Negative	Positive

PIRANI CLASSIFICATION OF CLUB FOOT DEFORMITY

Physical examination findings	Score of 0	Score of 0.5	Score of 1
Curvature of lateral border of foot	straight	Mild distal curve	Curve at calcaneocuboid joint
Severity of medial crease	Multiple fine creases	One or two deep creases	Deep creases change contour of arch
Severity of posterior crease	Multiple fine creases	One or two deep creases	Deep creases change contour of arch
Medial malleolar-navicular interval	Depression felt	Interval reduced	Interval not palpable
Palpation of lateral part of head of talus	Navicular completely reduces, talar head cannot be felt.	Navicular partially reduces, lateral head less palpable	Navicular does not reduce, lateral talar head easily felt
Emptiness of heel	Tuberosity of calcaneus easily palpable	Tuberosity of calcaneus more difficult to palpate	Tuberosity of calcaneus not palpable
Fibula-achilles interval	Definite depression felt	Interval reduced	Interval not palpable
Rigidity of equinus	Normal ankle dorsiflexion	Ankle dorsiflexes beyond neutral, but not fully	Cannot dorsiflex ankle to neutral
Rigidity of adductus	Fore foot can be over corrected into abduction	Forefoot can be corrected beyond neutral,but not fully	Forefoot cannot be corrected to neutral
Long flexor	MTP joints can	MTP joints can	MTP joints

contracture	be over corrected into abduction	be dorsiflexed beyond neutral but not fully	cannot be dorsiflexed to neutral

COLEMAN classified according to the response treatment :

1. Resistant : fails to correct by non operative methods.

2. Relapse : correction achieved by either operative or non operative but recurred.

3. neglected : No treatment undertaken during infancy

Carroll 10 points scoring system useful for preoperative evaluation :

1. Calf atrophy
2. Position of bimallelar axis
3. Creases
4. Cavus
5. Fixed equinus
6. Navicular fixed to the medial malleolus
7. Oscalcis fixed to the fibula
8. Midtarsal mobility
9. Forefoot supination
10. Rigidity of adduction

CLINCAL EVALUATION

Congenital clubfoot must be differentiated from postural and structural or secondary type of clubfoot. The postural clubfoot has the clinical appearance of congenital clubfoot, but it can become fully correctable to normal anatomic position at birth, or shortly thereafter following a period of manipulative strapping.

The patient should be thoroughly examined to exclude features of paralytic clubfoot including multiple congenital malformations.

In General Examination : exclude the following clinical condition causing secondary club foot

- Neurological lesion that can cause the deformity "Spina Bifida"
- Other abnormalities that can explain the deformity "Arthrogryposis, Myelodysplasia"
- Presence of concomitant congenital anomalies

Assessment of Internal Tibial torsion :

It occurs when the angle between axis between the rotation of the knee and trimallelar axis is altered. Lesser deformities will usually resolve It will decrease the range of movement of knee and talar joint. if it is more than 15 degree and persist after 8 years surgical correction is indicated.

LOCAL EXAMINATION OF FOOT AND LEG :

- Achilles tendon : severity of shortening
- Heel size : small or normal
- Skin creases : behind the Heel, medial crease and posterior crease
- Callosities : abnormal pressure areas
- Internal torsion of the leg
- Calf muscles wasting

TREATMENT

OBJECTIVES :

1. To achieve concentric reduction of the dislocation or subluxation of the talocalcaneonavicular joint.
2. To maintain the reduction.
3. To restore the normal articular alignment of the tarsus and ankle joint.
4. To establish the muscle balance between the evertors and invertors, and the dorsiflexors and plantarflexors.
5. To provide a mobile foot with normal function and weight bearing.

NONOPERATIVE TREATMENT:

The initial treatment of clubfoot is nonoperative. Various treatment regimens have been proposed, including the use of corrective splinting, taping, and casting.

Manipulation :

Manipulation should be gentle but yet strong enough to stretch the soft tissue contractures. Forceful manipulation may result in a spurious correction producing rocker bottom foot. Thus, attempts are made to correct all elements of the deformities simultaneously. Treatment consists of weekly serial manipulation and casting during

the first 6 weeks of life, followed by manipulation and casting every other week until the foot is clinically and roentgenographically corrected.

Kite corrected each component of the deformity separately instead of simultaneously. He was able to correct the cavus and to avoid foot pronation, but correcting the heel varus took many casts. He recommended “getting all the correction by abducting the foot at the midtarsal joint” with the thumb pressing “on the lateral side of the foot near the calcaneocuboid joint.” The order of correction by serial manipulation and casting should be as follows: first, correction of forefoot adduction; next, correction of heel varus; and finally, correction of hindfoot equinus. Correction should be pursued in this order so that a rocker-bottom deformity will be prevented by dorsiflexing the foot through the hindfoot.

In **Ponseti** casting technique, all the components of the clubfoot deformity have to be corrected simultaneously with the exception of the equinus which should be corrected last. The cavus results from a pronation of the forefoot in relation to the hindfoot, and is corrected as the foot is abducted by supinating the forefoot and thereby placing it in proper alignment with the midfoot. While the whole foot is held in supination and in flexion, it can be gently and gradually abducted under the talus, and secured against rotation in the ankle mortise by applying counter-pressure with the thumb against the lateral aspect of the head of the talus. The heel varus and foot supination will correct when the entire foot is fully abducted in maximum external rotation under the talus. The foot should never be everted. After the above is

accomplished, the equinus can be corrected by dorsiflexing the foot. The tendo-Achilles may need to be subcutaneously sectioned to facilitate this correction.

When proper treatment of clubfoot with manipulation and plaster casts has been started shortly after birth, a good clinical correction can be obtained in the vast majority of cases. A plaster cast is applied after each weekly session to retain the degree of correction and soften the ligaments. After two months of manipulation and casting the foot often appears slightly overcorrected. If the clubfoot is corrected by the time the child is 6 months of age, this should be documented by both the clinical appearance and repeated anteroposterior and dorsiflexion lateral stress roentgenograms. The foot can be placed in an ankle-foot orthosis that can be used part-time on children with compliant families.

SURGICAL MANAGEMENT

The general concept in the surgical treatment of clubfoot is to achieve complete and permanent correction with one operation . Decision to choose the categories of operative procedures depends on age of patient, degree of rigidity and presence of deformity.

The surgical procedures that are currently in use can be divided into three basic

groups.

These procedures are

1. Soft tissue procedures
2. Combination of soft tissue and bony procedures
3. Bony procedures.

SOFT TISSUE PROCEDURES :

The procedure that involves soft tissue consist of release or lengthening of tight , deforming soft tissue structures such as ligaments, joint capsules and tendons, as well as performing tendon transfers. The incision used vary widely, but what is performed beneath the skin is far more important to the result than the incision itself. The simplest soft tissue procedure is the posterior release , which involves tendo Achilles lengthening, posterior capsulotomy of ankle and subtalar joints and sectioning of the calcaneofibular and posterior talofibular ligaments, as these ligaments prevent dorsiflexion of the talus.

The comprehensive soft tissue release includes the posteromedial release of Turco and circumferential release. Tendon transfer is occasionally performed to provide dynamic balance between the evertors and invertors.

COMBINATION OF SOFT TISSUE AND BONY PROCEDURES :

In the child whose tarsal and metatarsal bones have become deformed and resist correction, a combination of soft tissue release and various bony procedures are considered. In older children between five to eight years of age, a combination of soft tissue release and Lichtblau procedure (resection of distal end of calcaneum) is recommended.

In those older than nine years of age, the lateral column of the foot is shortened and stabilized by calcaneocuboid resection and fusion. A combination of soft tissue release with a medial opening wedge osteotomy of calcaneum and insertion of a bony wedge is also described.

BONY PROCEDURES :

In general, bony procedures are rarely if ever, indicated in the infant and young child as these will disturb the normal growth and development of the foot. In a skeletally mature foot (more than ten years old), osteotomy of the os calcis, tarsal reconstruction and triple arthrodesis are required as salvage procedures. Metatarsal

osteotomy at their bases will correct the varus forefoot, Dwyers osteotomy of the calcaneus corrects hindfoot varus and medial rotation osteotomy of the tibia may be indicated to correct severe lateral rotational malalignment of the tibia and fibula .Occasionally, a talectomy is performed.

COMPLICATIONS OF SURGICAL TREATMENT

WOUND INFECTION AND WOUND DEHISCENCE

This is the most common complication following clubfoot surgery. This can be prevented by preoperative stretching of soft tissues and meticulous surgical technique. The tourniquet should be released and complete hemostasis obtained before skin closure and the initial cast applied with ankle in plantar flexion. Wound infection is an unfortunate complication, if develops wound is debrided and closed primarily. It is best not to leave the wound to granulate, if the wound granulates it results in excessive scarring and recurrence of deformity.

CALCANEUS DEFORMITY

This is caused by overcorrection of deformity. Overlengthening of tendo Achilles weakens the plantarflexion of the ankle and results in further weakening of the motor function of tendoachilles. Progressive resistive ankle exercises, tip toe rising execises will improve the function of the tendoachilles. Rarely operative shortening of

tendoachilles is needed.

RESTRICTED PLANTARFLEXION OF THE ANKLE JOINT

It is due to contracture of the anterior capsule and the ligamentous tissues of the ankle joint. This complication can be avoided by gentle stretching of the ankle joint postoperatively by dorsiflexion followed by plantar flexion.

ANKLE VALGUS

This is caused by division of the medial part of the deep deltoid ligament. If at surgery this ligament is inadvertently cut, it should be repaired immediately. Late repair of deep deep deltoid ligament does not yield good results. Best results are obtained by opening wedge laterally based (Dwyer) osteotomy.

GROWTH ARREST OF THE POSTERIOR TIBIAL PHYSIS AND DISTAL FIBULAR PHYSIS

This results from injudicious posterior capsulotomy or inadvertent trauma to the growth plate when calcaneofibular ligament is sectioned. Disturbances of growth plate results in ankle valgus. Treatment options are physeal bar resection and distraction lengthening of the tibia or fibula. ..

HINGED VALGUS AND ROTATORY VALGUS

Hinged valgus at the subtalar joint occurs when complete posteromedial release and division of talocalcaneal interosseous ligament are performed and the lateral subtalar capsule intact, the result is the calcaneus hinges beneath the talus. It is prevented by completely or partially leaving the talocalcaneal interosseous ligament intact.

Rotatory valgus results from overcorrection of horizontal rotation of the calcaneus beneath the talus around a vertical axis that passes through the talocalcaneal interosseous ligament upward through tibia. It is prevented by the pinning the subtalar joint with Steinmann pins,in normal anatomic position when complete peritalar release is performed.

COMPLICATIONS INVOLVING THE PROXIMAL TARSAL JOINT

1. Talonavicular subluxation
2. Calcaeocuboid subluxation
3. Posterior cavus
4. Sagging or collapse of the medial longitudinal arch
5. Supination deformity taking palce at the talonavicular joint

All these complications can be avoided by complete release achieved during surgery.

METATARSUS VARUS AND FOREFOOT ADDUCTION

It is due to inadequate release or failure to release the contracted soft tissue on the medial aspect of the foot, namely abductor hallucis, capsules of the first metatarsal cuneiform and plantar fascia. It is measured by the weight bearing anteroposterior radiograms, the angle between proximal articular surface of the navicular bone and the longitudinal axis of the first metatarsal. A value in excess 100 degrees confirm the diagnosis. Treatment complete erasure of abductor hallucis and osteotomy of the base of second metatarsal.

REVIEW OF LITERATURE

Magone et al in 1989 reviewed all the three soft tissue procedures done at Columbus Children Hospital and was unable to definitely state which procedure is better . Laveeg Ponsetti have reported 70%-91% of good to excellent correction on patients underwent posteromedial release before 6 months of age, and 50% relapse rate when this procedure was done after 9 months old .

Thomsan et al in 1991 reviewed the results of surgical treatment of clubfoot and concluded that decreasein foot size,calf atrophy and the discrepancy in the tibial length are expected finding in any child with clubfoot deformity. These are closely related topathological anatomy of clubfoot and thus are not affected by mode of treatment and were not considered in the assessment of clinical results.

Comparison of a group of children who underwent posterior release with a more recent group treated with ‘comprehensive’ release. Results much the same, but the Laaveg and Ponseti scores were much worse in the children who had had more operations, who had hindfoot varus or who had an abnormal lateral talocalcaneal angle .

Study by Turco of 149 children operated on between the ages of 6 months and 8 years using his technique. Follow up was for 2-15 years. 80% good or excellent results assessed using the authors own scoring system. Comments that there are no

normal feet after surgery for clubfoot.

Case series of patients treated with modified Turco procedure. Results in children aged 1 to 5years appear good with 94% satisfied, despite a 21% recurrence rate.

MATERIALS AND METHODS

In this study we prospectively followed up 64 children with 86 clubfeet of varying degrees of deformity who were treated between June 2007 – May 2009. 40 patients with 52 idiopathic club feet had surgical correction either by Turco's technique or Modified Turco's technique. The remaining 24 children were treated by nonoperative methods.

Patients selected for operative procedure were grouped into Group A and Group B. In Group A 20 patients selected randomly, of which nine patients were boys, eleven patients were girls and 4 patients were bilateral (two boys, two girls). One patient did not come for follow up. Patients age were between four months to one year, an average of seven months.

In Group B 20 patients selected randomly of which sixteen patients were boys, four patients were female and eight cases were bilateral (six boys and two girls). Patients age were between four months to one year, an average of seven months.

Patients in Group A underwent surgery by posteromedial release by Turco's procedure. Patients in Group B underwent surgery by Modified Turco's procedure. The children in both the groups were followed up prospectively every month for the first six months after that once in 3 months. Postoperative clinical and radiological evaluation were done once in three months and their results were recorded. Total duration of follow-ups in both groups were from six months to twenty four months, an average of fifteen months.

Table 1 : Clinical Material

Variables	male	female	Total
Group A	9	11	20
Group B	16	4	20
Bilateral cases	7	5	13
Number of patients	25	15	40
Number of feet	32	20	52

Selection criteria

Idiopathic clubfoot age between four months to one year

Late presentation upto one year of age

Failure of conservative treatment

Exclusion criteria

Teratologic clubfoot

Resistant clubfoot

Recurrent clubfoot

Neglected clubfoot

Timing of surgery

There is a lot of growth potential during the first year of life hence greater potential for remodelling . If the bony architecture is properly aligned at an earlier age this should promote congruous development of calcaneocuboid, talonavicular joint. Surgery indicated when

1. Conservative treatment fails at 4 months of age
2. Child weight more than 5 kilogram of weight
3. Size of foot length more than 8 cm

All the patients were examined thoroughly and the severrity deformity were classified according to Dimeglo and Pirani scoring system (Table 2)

Table 2 : Assessment severity of the defromity

Dimeglo grading	Group A number of feet	Group B number of feet
Grade 1	Nil	Nil
Grade 2	2	1
Grade 3	16	14
Grade 4	6	11

All patients with congenital clubfoot began receiving treatment starting at or soon after birth. The mother was taught to manipulate the child's feet for the first two weeks. All patients started plaster cast treatment at the age of two weeks of age. The plaster cast was applied with the patient under sedation after manipulation and the

deformity was serially corrected as described by Ponsetti. Plaster cast was changed every week for the first six to eight weeks afterwards every two weeks to achieve good correction for next six to eight weeks. patient had various peocedures including perrcutaneous tendoachilles lengthening and minimal release to full posteromedial release depending upon the correction achieved. In our study most of the patients were neglected presented very late up to six months. All the patients were operated under the guidance of senior professor between four months to one year.

Group A patients were operated by Turco's procedure. Patients under general anesthesia or caudal block and in supine position. Thigh tourniquet was used in all patients. Posteromedial incision extending from the base of first metatarsal to the medial border of tendoachilles proximally up to 10cm ,curving it gently just inferior to the medial malleolus. Do not undermine the skin. Next the tibialis posterior, flexor digitorium longus, flexor hallucis longus and the posterior tibial neurovascular bundle were exposed and mobilised. The neurovascular bundle was separated and retracted it posteriorly. Continued the incision in the sheathe of flexor digitorium longus and flexor hallucis longus divided the master knot of Henry beneath navicular. Divided the spring ligament tand abnormal origin of abductor hallucis. Lengthened the tendoachilles by `Z` plasty technique,detaching the medial half of its tendinous insertion on the calcaneus. Re The neurovascular bundle was retracted anteriorly and exposed posterior capsule of the ankle joint .The capsule of ankle joint and the posterior capsule of the subtalar joint were divided. The neurovascular structure was retracted posterioly exposed and divided or lengthened by `Z ` plasty of tibialis

posterior tendon. The flexor digitorium longus, flexor hallucis longus superficial part of deltoid ligament from the calcaneus posteriorly were dvided. After complete release of the talonavicular joint,the navicular was reduced over talar head. The skin and subcutaneous tissue were closed with interrupted sutures. Applied Well padded long leg cast with knee in minimal flexion ankle in neutral position. At 2 weeks long leg cast changed and the ankle kept in more dorsiflexion and was continued for 3 months with full correction. Ankle foot orthosis continued until the child was at least 1.5 years old ,or had active dorsiflexion beyond the neutral position of ankle.

Group B patients were treated by modified Turco's procedure. The modifications were

1. Lateral position with the unaffected side on top in unilateral cases.
2. Cincinatti type transverse heel crease incision from the base of first metatarsal around the ankle up to the lateral border of tendoachilles.
3. Abductor hallucis muscle was excised completely.
4. Complete posterior tibial tendon tenotomy in the sheath.
5. No lengthening of long toe flexors.

All the patients in both groups were followed up by us. At follow up, the clinical examination done to evaluate the scar, calf size, residual foot deformity, heel position and shape of the foot. At the end of sixth month all patients in both groups were evaluated by pirani and dimeglo scoring system and was documented. Wound

complications and degrees of forefoot aduction were recorded individually in both groups. The results of the patients in both groups were compared and documented.

All patients had two standard radiographs taken: stressed anteroposterior of the foot and stressed lateral of the foot. From these radiographs, the AP and lateral talocalcanealangles and talocalcaneal index, AP first metatarsotarsal angle were measured as described by Beatson and pearson.

POST OPERATIVE PROTOCOL

1. Above knee slab with knee in 45 degree flexion and the ankle joint in plantar flexed position there by reduce the tension of the skin edges of the wound.
2. After two weeks suture removal and manipulation of foot into maximal plantar flexion and dorsiflexion there by prevents anterior capsular contracture. Then above knee cast with knee in slight flexion and the ankle in neutral
3. Above knee cast changed after two weeks following cast removal gentle mobilization exercises given to the ankle joint to prevent anterior capsular contracture.
4. Above knee cast changed once in two weeks and continued for sixteen weeks.

5. Below knee walking cast upto one year of age .
6. Clubfoot applied once the child started walking up to eighteen months.
7. Denis Browne splint not used because of manufacturing costs.

ASSESSMENT OF RESULTS

Clinical assessment :

1. Residual foot deformity

2. Heel position and shape

3. Ankle and hind foot movement

4. Pain on activity

Radiological assessment : Talocalcaneal index

Results of treatment were graded Excellent, Good and Poor on the criteria given below

Good

Foot normal function and appearance

Acceptable

Relatively normal appearance and function of the foot

No fixed deformity

Ability to dorsiflex and evert the foot to neutral postion

Talocalcaneal index more than 30 degrees

Poor

Limited activity

Residual fixed deformity

Inability to dorsiflex and evert the foot to neutral.

Talocalcaneal index less than 30 degrees.

RESULTS

In this study we present patients who were separated in two groups. Group A 20 patients with twenty four clubfeet were operated by posteromedial release described by Turco, and Group B 20 patients with 28 clubfeet were operated by modified Turco's technique. In Group A out of 24 feet 4 feet (16.6%) had excellent results,12 feet (50%) good results and 8 feet (33.4%) had poor results. In Group B out of 28 feet 10 feet (35.7 %) had excellent results, 14 feet (50%) had good results and the 4 feet (14.3 %) had poor results (table 3). The comparison also revealed more poor complications related to the Group A 8 of 24 feet(33.4 %). Comparison of excellent and good results of bothgroups with the function and range of movement of the unaffected side were slightly more limited in dorsiflexion but the differences were not significant in unilateral cases.

The comparative radiological measurements of talocalcaneal index of both groups showed slightly more decrease on group A patients. In group A out of 24 feet 8 feet had recurrence of forefoot adduction in compared to group B in which only 4 feet of 28 feet had recurrence of forefeet adduction. In group A two feet had recurrences of all deformities and in Group B only one foot had recurrence of all deformities (heel varus, forefoot adduction and equinus (table 4). Wound complications were more in group A (sixteen of 24 feet) than Group B (ten of 28 feet). Wound complications were in the form of superficial wound infection, wound dehiscence, necrosis of the edge of the wound (table 5).

Table 3 : Distribution of results of treatment

Study group	Total number of feet	Excellent	Good	Poor
Group A	24	4 (16.6%)	12 (50%)	8 (33.4%)
Group B	28	10 (35.7%)	14 (50%)	4 (14.3 %)

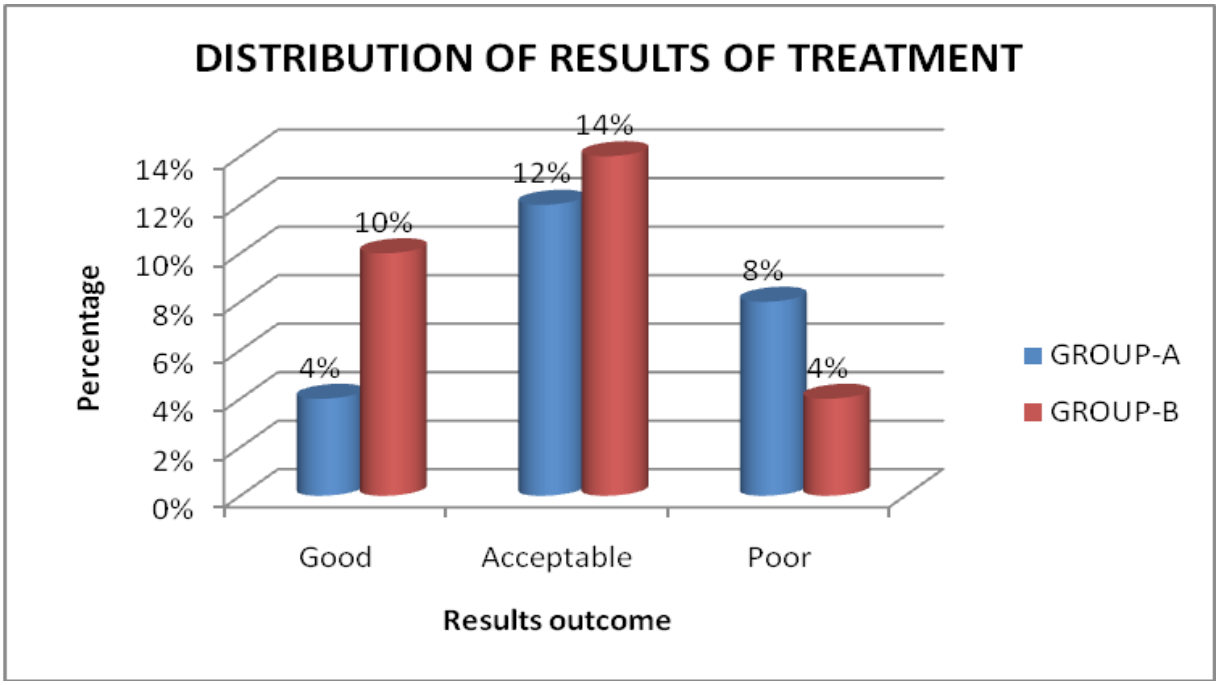


Table 4 : Recurrence of deformity

Study groups	Total number of feet	Forefoot adduction	Heel varus	Equinus
Group A	24	8 (33.3 %)	4 (16.6 %)	2 (8.8 %)
Group B	28	2 (7.1 %)	3 (10.6 %)	1 (3.5 %)

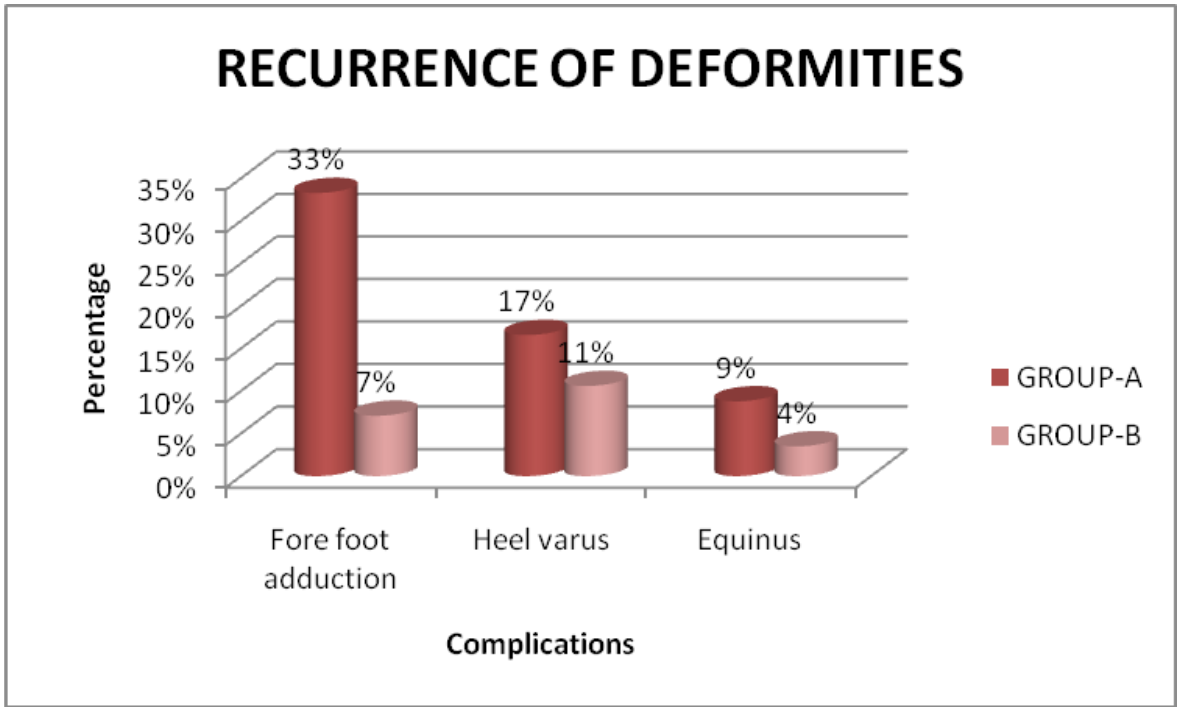
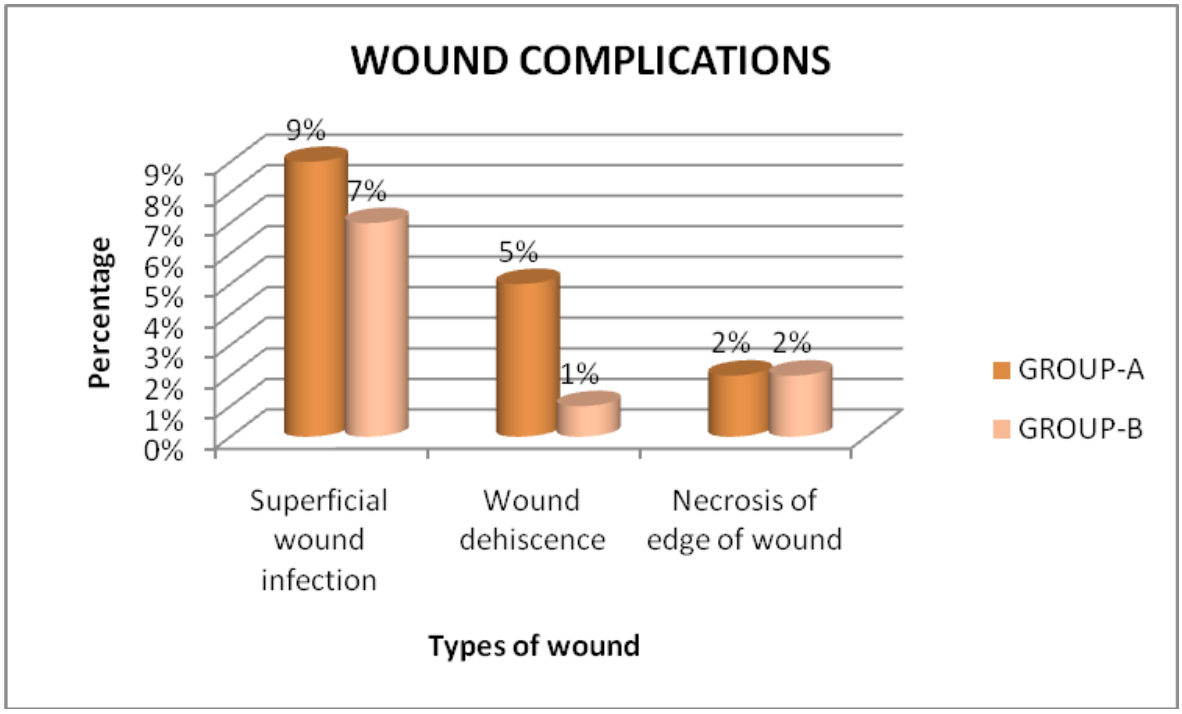


Table 5 : Wound complications

Type of wound	Group A (24 feet)	Group B (28 feet)
Superficial wound infection	9 (26.6 %)	7 (25 %)
Wound dehiscence	5 (20.8 %)	1 (3.5 %)
Necrosis of edge of wound	2 (8.3 %)	2 (7.1 %)



DISCUSSION

The treatment of clubfoot is still controversial due to different severity and different treatment philosophies. The comparison of success rate for the treatment of any surgical condition is complicated by two factors, variation between two groups and absence of common assessment protocol.

Where bony deformity at birth is well documented it is unreasonable to expect that treatment either by plaster of paris or by surgery will restore the normal anatomy in more deformed feet.

Trearment starts from manipulation , serial corrective cast to extensive surgical release depends on their severity of deformity at birth. The ponsetti conservative method serves the best results when it starts early and is preformed by all orthopaedic surgeons. The literature on surgical management of clubfoot is extensive and there is considerable difference in opinions as to the indications for surgery and to the optimal procedure which is to be used. It is generally agreed that, if surgery is necessary in young children, it should consist only of soft tissue procedures. Indications for posterior release is a persisting equinus of hindfoot or hindfoot and fore foot and an Anteroposterior and Lateral radiographs shows normal talocalcaneal angle. Hindfoot equinus and varus and passively corrected medial spin are successfully treated by posteromedial release. Posteromedial – lateral release is indicated when there is partially correctable medial spin deformity. If the foot has stiff varus and stiff medial spin deformity complete subtalar release is indicated. Extensive posteromedial release as described by Turco, exposes most of the anatomic elements anterior and posterior

tibialis tendon, flexor hallucis longus and flexor digitorum longus tendons and Achilles tendon.

The new technique described in this paper was initially elaborated after extensive experience with the Turco technique. The advantages of the this new technique are achieving adequate correction of deformity and decreased incidence of recurrence of deformities and wound related complications. Forefoot adduction is the most recurring deformity and its incidence ranges from 8% to 33%. The pull of abductor hallucis is the one of the cause for recurrence of adduction deformity of the forefoot. Release of abductor hallucis is considered as a part of medial release of the Greenville method. Recession of the origin of the abductor hallucis and release of short plantar muscles at the time of posteromedial release are recommended to avoid recurrence of adductus deformity of forefoot. The incidence of recurrence of forefoot adduction was found to be 7.1% in this modified technique when compared to Turco procedure which was 33%. Wound healing is the known problem with extensive release surgery. Meticulous dissection during surgery is required to achieve good results. Complete excision of the abductor hallucis provides easier closure of the wound, which can be problematic in rigid and grossly deformed foot. Wound healing complications were only 8.9% in modified technique when compared to routine posteromedial release by Turco's technique (29.3 %). With this new surgical technique it is possible to provide patients with a functional, pain-free, normal-looking foot, with good mobility, without calluses, and requiring no special shoes.

CONCLUSION

Congenital clubfoot is still a subject of controversy and remains a significant problem owing to the unknown aetiology and disputed pathoanatomy. Moreover, there are no satisfactory methods for early objective assessments and consensus on the value of radiographs in the routine management. The results of any form of treatment vary according to early presentation for treatment, severity of the deformity and surgeon's philosophy on the deformity. In our study ,comparing the results of two different surgical techniques, the recurrence of deformity especially forefoot adduction and the wound complications were very less when comparing to the routine posteromedial soft tissue release by Turco technique. Some facts should be in mind before club foot surgery is performed.

Walking and weight bearing on an uncorrected clubfoot increases the deformity. Undercorrection leads to relapse. Overcorrection leads to severe foot problems during adolescence.

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PROFORMA

DEPARTMENT OF ORTHOPAEDICS
TIRUNELVELI MEDICAL COLLEGE
TIRUNELVELI

CLUB FOOT CLINIC

NAME : AGE : SEX :

ADDRESS : OPNO : UNIT :

BIRTH HISTORY :

MARRIAGE : CONSANGUINOUS /NON CONSANGUINOUS :

FAMILY: HISTORY OF CTEV : YES/NO

EXAMINATION OF SPINE :

PREVIOUS TREATMENT DETAILS :

DIAGNOSIS : UNILATERAL [RIGHT/LEFT] BILATERAL

BEFORE CASTING AFTER CASTING

DIMEGLO GRADE -

PIRANI SCORE

SERIAL CORRECTIVE CASTING [PONSETTI] COMPLICATIONS

I

II

III

IV

V

VI

VII

VIII

PLAN :